Chapter 7. Personnel Monitoring.

7-1. External Monitoring.

a. To indicate the amount of radiation to which a person has been externally exposed, an individual monitoring device may be used. NRC regulations define an "individual monitoring device" as a device designed to be worn by a single individual for the assessment of dose equivalent. Examples of dosimeters include film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers ("pencils"), alarm rate meters, track etch dosimeters, and neutron sensitive film. NRC and OSHA regulations require that each *licensee* monitor occupational exposure to radiation and supply and require the use of dosimeters by:

(1) Adults likely to receive in one year from sources external to the body a dose in excess of 10 per cent of the limits specified in Chapter 4;

(2) Declared pregnant women likely to receive during the pregnancy, from sources external to the body a dose in excess of 10 per cent of the limits in Chapter 4; and

(3) An individual entering a high or very high radiation area.

b. Most individuals who work in radiation areas never approach values which require personnel monitoring. Statistical evaluations of monitoring results have shown that 70% of all monitored Authorized Users' Assistants receive no measurable exposure and another 20% receive less than 100 mrem per year. Exposure histories have documented the fact that usually only those individuals who work in radiology, radiography, and other fields using high activity sources are required to be monitored.

c. Within USACE, the RPO will determine which USACE personnel should wear dosimeters. USACE personnel are among the aforementioned large percentage of individuals which are not likely to receive a measurable dose. Dosimetry is issued, in most cases, to document low exposures.

d. The RPO will instruct personnel in the proper use of dosimeters, will issue dosimeters, will collect dosimeters and submit them for analysis, and will review the analysis results. Dosimeters (except direct and indirect reading pocket ionization chambers) will be processed by a laboratory which holds current accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of

Standards and Technology (NIST).

e. Most contractors use vendor supplied services. **USACE personnel will use the US Army Ionizing Radiation Dosimetry Center (USAIRDC) for dosimetry services.** Exposures shall be reported and recorded. Exposures shall be recorded using the computer generated printout generated by USAIRDC or NRC Form 5 (a copy for reference of the USAIRDC version of NRC Form 5 is attached at Appendix H). The program is administered from Redstone Arsenal and may be contacted at the following:

US Army Missile Command
Attn: AMSMI-TMDE-SR-D
Redstone Arsenal, AL 35898-5400
commercial phone number: (205)876-1858.

f. The four chip TLD is the standard US Army whole body dosimeter.

g. Personnel should not expose their dosimeter to security X-ray devices, excessive heat, or medical sources of radiation. Should job conditions dictate, dosimeters may be removed from a job site as part of an employee's routine travel to and from work. At sites where dosimeter use is routine, and there is a responsible individual to manage the dosimeters, the personal dosimeters should be stored at site and not taken home each night. A dosimeter shall be returned to the RPO if an employee will not be physically present at the job site for a period of one month or greater.

h. A person whose dosimeter is lost, damaged, or contaminated while working will immediately exit the radiation control area and report the occurrence to the RPO. Reentry of the person into the radiation control area will not be permitted without RPO approval. Dosimeters will not be utilized by USACE personnel for operations at locations other than USACE sites.

7-2. Internal Monitoring.

a. NRC regulations also require that each licensee monitor the occupational intake of radioactive material by and assess the committed effective dose equivalent to:

(1) Adults likely to receive in one year an intake in excess of 10 percent of the applicable ALI; and

(2) Declared pregnant women likely to receive during the pregnancy, a committed effective dose equivalent in excess of 50 mrem.

b. If a licensee is required to monitor both external and internal

exposures, then the external and internal doses must be summed to demonstrate compliance with the dose limits specified in Chapter 5.

c. Internal monitoring can be achieved via bioassay. A bioassay is a determination of the kind, quantity, or concentration and location of radioactive material in the body. A direct (*in vivo*) bioassay measurement may be made by whole body counting (that is, counting the gamma-rays emanating from a radionuclide in a given organ). An indirect (*in vitro*) bioassay measurement may be made by assessing the quantity of a specific radionuclide in samples that are excreted (for example, urine, feces, or blood). There are four types of bioassays:

(1) Baseline: Prior to potential exposure;

(2) Routine: At a specified frequency (for example, quarterly);

(3) Postoperational: Within two weeks of the last possible exposure when operations are being discontinued or when the worker is terminating duties with exposure to radioisotopes; and

(4) Diagnostic: Follow-up bioassay performed within two weeks of any measurement exceeding the action level. This will confirm the preceding measurement and allow an estimate of effective half-life.

d. Within USACE, personnel shall participate in a bioassay program when they are likely to receive an intake that may result in a committed effective dose equivalent of 100 mrem or more, or, when an intake of radiation is suspected for any reason. Specific bioassay requirements will be determined by the RPO for each job site. Bioassay procedures, supplies, lab analysis and dose assessment may be obtained on a cost reimbursable basis from the US Army Center Health Promotion and Preventive Medicine (USACHPPM), Radiochemistry and Analysis Program (RAP), commercial phone,(410) 671-3983.

e. Personnel shall be notified promptly of positive bioassay results, as well as the results of dose assessments and subsequent refinements. Dose assessment results shall be provided in terms of mrem to the organ(s) and whole body.

f. Personnel should participate in diagnostic (follow-up) bioassay monitoring when their routine bioassay results indicate an intake in the current year with a committed effective dose equivalent of

100 mrem or more.

g. Management should require a post-operational bioassay when a person who participated in the bioassay program terminates employment or concludes work involving the potential for internal exposure.

7-3. Advanced Monitoring.

a. Multiple dosimeters may be issued to personnel to assess whole-body exposure in nonuniform radiation fields or as required in radiation work plans. Nonuniform radiation fields exist when the dose to a portion of the whole body will exceed the dose to the primary dosimeter by more than 50 percent, and, the anticipated whole-body dose is greater than 100 mrem.

b. The use of an alarm rate meter is encouraged for entry into a high radiation area or when a planned dose of greater than 100 mrem in one week is expected. An alarm rate meter provides an early warning of elevated exposure through the use of a preset dose rate or an integrated dose. A direct reading (pencil) dosimeter may be used in place of an alarm rate meter. A pencil dosimeter with the lowest range applicable (typically 0-200 mR) should be selected. The alarm rate meter or the pencil dosimeter should be worn simultaneously with the primary dosimeter. The alarm rate meter or pencil dosimeter should not be allowed to exceed 75 per cent of full scale.

c. The establishment and maintenance of a comprehensive area monitoring program may minimize the number of areas requiring the issuance of personnel dosimeters, and, demonstrate that doses outside radiation work areas are negligible. Minimizing the number of personnel dosimeters issued lowers the costs of operating the dosimetry program and reduces costs associated with maintaining personnel with enhanced training and qualifications.

d. Area-monitoring dosimeters should be used in controlled areas to supplement existing monitoring programs, and to provide data in the event of an emergency. Area-monitoring dosimeters should be used to record and document radiation levels in routinely occupied areas that are adjacent to areas where radiation, or operations with radiation exist. Area-monitoring dosimeter results could be used to support dosimetry investigations if personnel express concerns about their work environments and possible exposure to ionizing radiation.

e. Any pregnant worker who

wishes to voluntarily enroll in the fetal monitoring program needs to contact the RPO.

(1) The worker will be provided with a declaration of pregnancy statement which the RPO will use to calculate the dose received from the date of conception until the date of declaration. An example of this statement is included at Appendix H (if Social Security Number is used ensure proper privacy act statement is provided). Exposure limits for the remaining allowable dose will be set at that time.

(2) A copy of the completed declaration of pregnancy statement, NRC Regulatory Guide 8.13, and a fetal monitoring dosimeter will be provided to the declared pregnant worker as soon as practical. The fetal monitoring dosimeter is to be worn at waist level versus the standard whole body dosimeter which is worn at the collar. If a lead apron is utilized, the fetal dosimeter is worn under the apron and the whole body dosimeter outside the apron.

(3) The exposure levels for fetal monitoring dosimeters will be closely evaluated throughout the entire gestation period by the RPO. A fetal ALARA level has been set by the RPSO at an exposure of 40 mrem/month. Should this level be exceeded, the declared pregnant worker will receive immediate notification, and actions will be taken to reduce any further exposure.

(4) At the end of the pregnancy, or if the worker rescinds her pregnancy declaration and wishes to cease fetal monitoring, the declared pregnant woman should contact the RPO to discontinue the fetal monitoring dosimeter. A fetal exposure final report will be generated.

7-4. Exposure Reporting.

a. The RPO will furnish each worker annually with a written report of the worker’s dose.

b. At the request of a worker who is terminating employment, the RPO will provide (within 30 days of the request) a termination report regarding the radiation dose received by that worker for the current year or fraction thereof. If the most recent results are not available at that time, a written estimate of the dose will be provided with a clear indication that this is an estimate. The RPO can obtain this information from USAIRDC.

c. It is each individual’s responsibility to notify the RPO when they terminate work involving radiation exposure.

d. A worker formerly engaged in activities controlled by USACE, may request a written report of his/her exposure to sources of radiation for each year that he/she was monitored. The report will be prepared by the RPO, will cover the period of time that the worker's activities involved exposure to radiation, will include the dates and locations of work, and will be furnished to the worker within 30 days of the request. The RPO can obtain this information from USAIRDC. The RPO can provide a detailed interpretation of a monitoring report form. Information which may be useful when reading a monitoring report is as follows:

(1) A **HARD** exposure relates to the whole body exposure (DDE);

(2) A **SOFT** exposure relates to a skin exposure (SDE);

(3) An **EYE** exposure relates to an exposure to the lens of the eye (Lens Dose Equivalent); and

(4) A dose of 000.000 or 'M' indicates a minimum reading. This means the dose for the monitoring period was below the minimum measurable quantity for the type of dosimeter used. Usual minimum values are as follows:

(a) Whole Body Badge - 10 mrem for X-and gamma-radiation, 40 mrem for energetic beta radiation; and

(b) Ring Badge - 10 mrem for X- and gamma-radiation, 30 mrem for energetic beta radiation.

e. Each RPO has information relevant to enrolling in the program. A DD Form 1952 (available through the local forms manager) must be completed and forwarded to the RPO.

f. All individuals must provide a dose history to the RPO if they are likely to have received in excess of 10% of any applicable annual limit. Additionally, any individual who had been monitored at another facility during the current calendar year must provide the RPO with pertinent exposure data. This exposure data will allow adjustments to be made so that the annual dose limits are not exceeded. Both of these are required prior to enrolling in the dosimetry program.

g. All personnel requiring bioassays will be sent a copy of their bioassay results on an annual basis. An individual may request the result of any bioassay at any time.